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NOTES ON THE TREMATODE GENUS TELORCHIS WITH DESCRIPTIONS OF NEW SPECIES*

HORACE W. STUNKARD

In 1889 Lühe created a new genus, *Telorchis*, to contain certain reptilian distome parasites, and designated *D. clara* Diesing (1850) as the type species. In the genus he included *D. poirieri* Stoss. (= *D. gelatinosum* Poirier nec. Rud.), *D. linstowi* Stoss. (= *Monostomum aculeatum* v. Linst.), *D. ercolanii* Montic. (= *D. signatum* Ercol. nec. Duj.), *D. nematoides* Mühl., *D. bifurcum* Braun, *D. pleroticum* Braun, and tentatively *D. arrectum* Mol. nec. Duj. His characterization of the genus states that the testes lie behind one another at the posterior end of the body; the cirrus sac opens somewhat left of the acetabulum and is very long; the ovary is immediately behind the posterior end of the cirrus sac and is separated from the testes by the coils of the well developed uterus; while the vitellaria consist of numerous follicles occupying the space at the sides of the body and approaching more or less closely the anterior and posterior ends. The diverticula of the intestine reach almost to the posterior end of the body; and with the exception of *D. poirieri* all species are armed with spines at the cephalic extremity of the worm. The excretory vessel is long and branches anteriorly in the form of a Y. The oral sucker is usually slightly larger than the acetabulum, though in *D. ercolanii* of the same size.

This same group of reptile distomes was separated by Looss (1899) independently, and also called *Telorchis*, but his article appeared after that of Lühe. Looss selected *D. linstowi* as the type species.

Because of the differences existing between *T. clara* and the other members of the genus, Lühe later (1900) created two subgenera: *Telorchis* with *T. clara* as type, and *Cercorchis* with *T. aculeatus* (= *T. linstowi* Stoss.) as the type. The distinguishing features of the sub-genus *Telorchis* are stated as the absence of an esophagus and the lateral extension of the folds of the uterus beyond the diverticula of the intestine where they may be coiled over the ceca in the form of a figure 8. In the sub-genus *Cercorchis* an esophagus is present and the coils of the uterus are confined between the ceca.

My examination of almost a hundred mature individuals of six different species affords evidence that the lateral extension of the uterus varies largely as a result of congestion with eggs. In the same species one finds some specimens in which the coils of the uterus are confined

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between the ceca and others in which the uterine folds overlap the diverticula on one or both sides. Certain species in the genus possess a long esophagus, others a short esophagus, and finally in *T. clava* an esophagus is absent. Furthermore the absence of an esophagus is not always associated with an extracecal coiling of the uterus, and vice versa, since in *T. bifurcus* an esophagus is absent and the uterine coils are intracecal, and in *T. corti* an esophagus is present and the uterine folds often overlap the ceca. These facts show that the characters designated by Lühe are not adequate to subdivide the genus, and since the apparent morphological differences of his types are merely extreme variations of characters common to several species, the sub-genera disappear.

Goldberger (1911) described as new species *T. stossichi*, *T. attenuatus* and *T. robustus*, and formulated a key for the identification and separation of the species.

The genus has a wide distribution, species having been reported from Sicily, Sardinia, Italy, France, Germany, Austro-Hungary, Turkey, Brazil, United States and Canada. So far as is known it is confined to reptilian hosts, species occurring in lizards, snakes and turtles.

The trematodes in this genus are elongate, with more or less parallel sides. The region of greatest width is at or anterior to the middle of the body. They range in length from 1.5 to 13 mm. and in width from 0.25 to 1.6 mm. In *T. arrectus* the ratio of width to length is 1:4, in *T. diminutus* it is 1:5, in *T. clava*, *T. bifurcus* and *T. lobosus* it is about 1:7, while in *T. pleroticus* it is 1:18 and in *T. poirieri* it is 1:22. That part of the body between the oral sucker and the acetabulum is much more motile than the post acetabular region, which is essentially a sac containing the reproductive apparatus.

The cuticula is of uniform thickness in any one worm; it varies from 2μ in *T. parvus* and *T. diminutus* to 11μ in *T. attenuatus*, the thicker cuticula being found in the larger species. Cuticular spines occur on the body arranged in a quincunx pattern and around the external openings in concentric circles. They are deeply imbedded in the cuticula which is raised about the base of each spine in a papilla like structure. Largest around the oral sucker, they gradually diminish in size toward the posterior end of the body where they are indistinct or entirely absent. The rows are separated by distances slightly exceeding the length of the spines. In general, the spines vary in size and proximity directly with the size of the worm. In one specimen of *T. robustus* 13 mm. long, the spines near the anterior end are 6.5μ apart and 5.7μ in length, and in another 6 mm. long they are 3.2μ apart and 3μ in length. In specimens of *T. lobosus* they are 2μ long and in rows

2.2μ apart, and in *T. diminutus* they are 1.5μ long and in rows 1.6μ apart. The cuticula turned in at the external openings is not spinous.

The musculature of the body (Fig. A) is light and delicate so that the worms are translucent.

The excretory system is typical for the genus. The pore is situated at the posterior tip of the body and opens from a large, median collecting duct (Fig. B) which extends anteriorly to about the location of the ovary; there it divides into branches that extend anteriorly, one on either side of the median line, just mesal to the intestinal diverticula. These branches can be traced almost to the region of the acetabulum where they disappear. In studying living specimens of *T. corti* I have been able to distinguish the flame cells, but their ducts could not be followed.

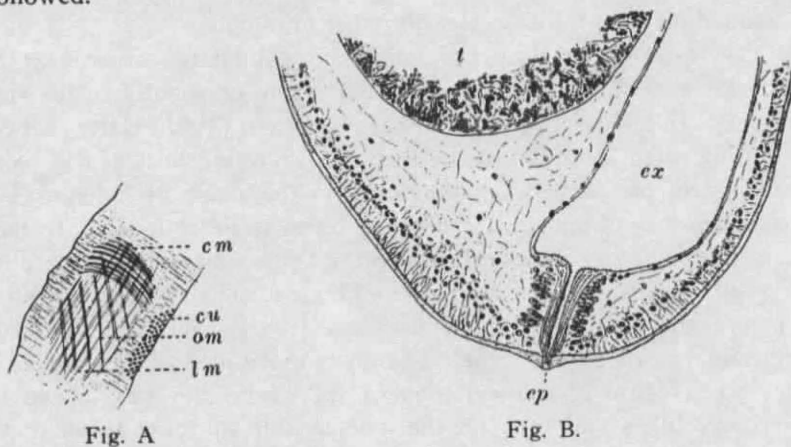


Fig. A

Fig. B.

Fig. A. Tangential section of body wall in *T. lobosus*, showing muscle layers and cuticular spines; *cu*, cuticula; *cm*, circular muscles; *lm*, longitudinal muscles; *om*, oblique muscles.

Fig. B. Sagittal section at median posterior end of body in *T. robustus*; *ep*, excretory pore; *ex*, collecting duct of excretory system; *t*, caudal testis.

The oral sucker is sub-terminal in position, equalling or slightly exceeding the acetabulum in size. The shape of both the oral sucker and acetabulum is subject to considerable variation as can be observed by watching the movements of a living worm. The shape of the sucker at the time of killing and the character of the reagents used influence the shape of the organ in the fixed material, although there seems to be a certain relation between the general shape of the sucker and the species.

A prepharynx is absent in *T. aculeatus* and *T. nematoides* and in some forms can be noted only when the cephalic extremity of the worm is much extended. All degrees of variation in length occur to a distinct

and elongated pouch in *T. bifurcus* and *T. pleroticus*. The pharynx is approximately spherical although either the longitudinal or transverse diameter may be greater. An esophagus is absent in *T. clava* and in *T. pleroticus*, short in *T. aculeatus* and *T. parvus*, and very long in *T. medius* and *T. solivagus*. The ceca meet anteriorly at an acute angle and extend almost to the posterior end of the body, terminating rarely (*T. parvus* and *T. poirieri*) in the inter-testicular zone, and in all other known species behind the caudal testis. Anterior to its bifurcation the digestive tract is lined with cuticula continuous with that of the external surface, and the ceca are lined with digestive epithelium, cells with nuclei close to the fibromuscular wall and cytoplasmic processes extending into the lumen of the canal. If the contents of the ceca are forced caudad the ends may be bulbous or flasklike in appearance, while if the caudal part of the excretory duct is much distended the ceca must necessarily taper gradually.

The testes lie in close proximity, one behind the other near the posterior end of the body, in the median line or slightly to the right and left. In his description of *T. parvus*, Braun (1901) states that due to the flattened condition of the body the collecting duct of the excretory system passes between the testes in the shape of a letter S so that when it is distended it causes the testes to lie obliquely. In most cases the excretory duct is dorsal to the testes and conditions are not those in *T. parvus*. The vasa efferentia pass cephalad, just median to the ceca, the duct from the cephalic testis on the left and that from the caudal testis on the right. The ducts move mediad and dorsad as they pass forward; at the region of the ovary they pass above the excretory tubes and then on the median side of these tubes to the posterior end of the cirrus sac where they empty into the vesicula seminalis. The cirrus sac (Fig. 1) is a long, cylindrical, muscular pouch extending caudad from the genital pore and enclosing the cirrus, vas deferens, prostate, and seminal vesicle. The genital pore is immediately anterior and at the left of the acetabulum. In one specimen of *T. corti* the cephalic testis had divided, the resulting organs lying one on either side of the median line. This specimen was not sexually mature and the vasa efferentia could not be traced.

The ovary is in or near the median line, posterior to the acetabulum, and usually just anterior to the center of the body. The oviduct arises from the dorsal posterior margin and after one or two slight irregularities it enlarges to form the ootype which is surrounded by the large unicellular glands of the shell gland. Figure 7 shows the structures of the female genital system in the vicinity of the ovary. Laurer's canal branches from the dorsal posterior part of the ootype and opens on the dorsal surface; the common vitelline duct enters the ootype just

ventral to and at the left of the origin of Laurer's canal. In some species the proximal end of Laurer's canal is enlarged to form a seminal receptacle and in *T. aculeatus* the enlargement may comprise the entire tube which in one case was filled with chromatin granules, in other instances no enlargement is present, as in *T. robustus*. The uterine tube turns first ventrad and then begins a series of irregular, sinuous convolutions, extending posteriad to the cephalic testis and returning anteriorly to the nearly straight metraterm which leads to the common genital sinus. The opening of the metraterm is anterior and at the left of the opening to the cirrus sac. The descending and ascending coils of the uterus occupy separate distinct fields in *T. aculeatus* and *T. parvus*; in *T. bifurcus* they overlap and are in some cases indistinct, while in *T. diminutus* and *T. nematoides* they are so superimposed and confused that only rarely can distinct fields be discerned. In *T. solivagus* Odhner (1902) reports that the descending and ascending limbs of the uterus cross each other to form a figure 8 and other authors mention this crossing or absence of crossing as a specific character, but in *T. corti* both conditions exist.

The vitellaria lie laterad of the ceca, and consist of a large number of follicles, usually arranged in lobes. Typically there are nine lobes on the right and twelve lobes on the left side of the body, although there is considerable variation from this condition. There is a tendency for the lobes to fuse, reducing the number, and the vitellaria of the left side extend farther cephalad and caudad than those of the right. In *T. aculeatus* the lobes are distinct, in most of the species they can be distinguished, while in others (*T. diminutus* and *T. robustus*) the vitelline follicles are not separated into lobes but extend along the sides in an unbroken series. Longitudinal collecting ducts occupy the median face of the vitellaria, and in the region of the ootype short ducts leading mediad from these unite near the median line of the body to form the vitelline receptacle from which the common yolk duct leads to the ootype.

In all sexually mature worms the uterus contains enormous numbers of eggs. They vary in size from 10 by 20 μ in *T. pleroticus* to 22.8 by 40 μ in *T. parvus*, and 21 by 41 μ in *T. diminutus*. It is interesting to note that in the smallest species, *T. parvus* and *T. diminutus*, the eggs are larger than in the largest species, *T. poirieri* and *T. robustus*, where they measure only 14 by 23 μ and 15 by 29 μ , respectively.

If the description given by Stafford (1900) and (1905) of *T. angustus*, and that by Barker and Covey (1911) of *T. leptus* are confirmed by further study, then these species do not belong in the genus *Telorchis* as conceived and discussed in preceding section of this paper. The long distance separating the acetabulum and the genital pore, the dorsolateral location of the latter, and the pre-acetabular position of

the cirrus sac form a complex of such striking and fundamental differences that a natural grouping will remove these forms from the genus *Telorchis*, thereby raising the sub-genus *Proteneis* Barker and Covey to generic rank. *Proteneis leptus* designated by Barker and Covey must be taken as type.

To Professor Henry B. Ward, under whose direction this work was done, I wish to express my appreciation for criticisms and suggestions.

Telorchis corti sp. nov. (Figs. 1, 4)

Specimens 4 to 7.15 mm. long; 0.35 to 0.5 mm. wide; greatest width at acetabulum, which is 0.14 mm. in diameter, one sixth to one seventh of body length from anterior end. Oral sucker same size as acetabulum; cuticular spines around former 3.4 μ in length. Pharynx 70 to 80 μ in diameter. Esophagus short, 50 μ long, 25 μ in diameter. Ovary spherical or slightly oval, in median line or just left of it, about three eighths of body length from anterior end; 0.117 by 0.147 mm. in the smaller specimens and 0.147 by 0.176 mm. in the largest; long axis parallel to that of body. Receptaculum seminis present; Laurer's canal opens just caudad of ovary. Uterus extends posteriad on left side, returning on right, rarely descending and ascending limbs cross about one third of distance from ovary to cephalic testis, forming a figure 8. Coils of uterus occasionally overlap diverticula through central half of distance from ovary to cephalic testis on one or both sides. Metraterm almost straight, extending caudad from genital pore one fourth to one third of distance to ovary. Vitellaria arranged in lobes; separate lobes often not distinct; begin about one-third of distance from ovary to acetabulum, cephalad of posterior end of cirrus sac; extend about five sixths of distance from ovary to cephalic testis. Twenty to forty follicles in each lobe. Testes spherical or oval, about equal in size, 0.2 to 0.29 mm. in length; 0.16 to 0.24 mm. in width; separated by 0.05 to 0.1 mm. Cirrus sac extends caudad from genital pore three fourths of distance to ovary; 1.12 to 1.18 mm. in length; 0.088 mm. in width. Vas deferens much coiled. Mature eggs average 31 by 15 μ ; those near ovary broader, measuring 30 by 19 μ .

In my material there are many immature specimens. The young worms are proportionately wider than the adults with the region of greatest width at the pharynx. The smallest mounted measured 0.65 mm. in length and 0.16 mm. in width. In this specimen the oral sucker is 0.085 mm. in diameter and the acetabulum is very small, 0.03 mm. in diameter. The esophagus is longer and the ceca are larger proportionately than in the adult. The cirrus sac, ovary and testes appear merely as masses of heavily staining cells. In a specimen 1.7 mm. long the body is 0.2 mm. in width. The suckers have increased in size, the oral to 0.09 and the acetabulum to 0.063 mm. in diameter. The intestine has acquired the shape characteristic of the adult, the ovary has assumed definite form, the testes have become more prominent, and the cirrus sac is well defined at the anterior end although the posterior end is extended as a line of deeply staining cells reaching to and apparently connected with the ovary. No trace of uterus or vitellaria could be distinguished.

A comparison of *T. corti* with *T. aculeatus* and *T. solivagus*, the species which it most closely resembles, shows that the forms are about the same length; *T. corti* is narrower and thicker than the others. The oral sucker and pharynx are smaller in *T. corti* and the esophagus is shorter. Odhner (1902) says that in *T. solivagus* the descending and ascending limbs of the uterus cross to form a figure 8; in *T. corti* both crossed and parallel conditions are present. In *T. aculeatus* and *T. solivagus* the cirrus sac extends from the genital pore caudad to the ovary, in *T. corti* it extends only three fourths of the distance to the ovary. In *T. aculeatus* the lobes of the vitellaria are more separate and distinct than in *T. corti*, and in *T. solivagus* they are not definitely arranged. In *T. aculeatus* they do not extend as far anteriorly or posteriorly as in *T. corti*. The eggs of *T. corti* are about the same size as those of *T. solivagus* and smaller than those of *T. aculeatus*.

Some fifty individuals of this species, most of them immature, were found in the intestine of seven specimens of *Malacoclemmys lescurei* from Newton, Texas. An adult worm was obtained from the intestine of a single specimen of *Chrysemys elegans* from the same region. The species was also collected in June, 1910, at Havana, Ill., from the intestine of *Malaccoclemmys geographicus*.

This species was named in honor of Dr. W. W. Cort.

Telorchis lobosus sp. nov. (Fig. 3)

Adults 1.67 to 2.6 mm. in length; 0.27 to 0.37 mm. in width, greatest width near center of body. Acetabulum circular, about two sevenths of total length from anterior end, in mounted specimens from 0.117 to 0.18 mm. in diameter. Pharynx 55 to 63 μ in diameter. Ovary oval, median, crosswise of the body, midway between anterior and posterior ends; from 40 to 70 μ in shorter and 74 to 85 μ in longer diameter. Small receptaculum seminis present, Laurer's canal passes directly dorsad, opening just above the ovary. Follicles of vitellaria massed together closely; lobes distinguished only at ends of areas. On left side vitellaria extend anteriorly about one third of distance from ovary to genital pore, and posteriorly about seven eighths of distance from ovary to cephalic testis. Vitellaria of right side do not extend so far anteriorly or posteriorly as those on left. Normal eggs measure from 18 by 32 μ to 19 by 36 μ . Testes oval, lobulated; their long axis perpendicular to that of worm; from 0.1 by 0.05 to 0.13 by 0.08 mm., very close together but not overlapping in any case. Caudal testis about its own length from posterior end of body. Cirrus sac extends from genital pore caudad to ovary; vas deferens not coiled as much as in *T. corti*.

In size and structure *T. lobosus* agrees most closely with *T. nematoides*, but a comparison with the description of Mühling shows specific differences. The forms are similar in the extent of vitellaria, cirrus sac, and size of eggs; but *T. lobosus* is smaller, shorter and flatter than *T. nematoides*, the suckers and pharynx are smaller, the esophagus is much shorter, and striking differences are noted in the ovary and testes.

Nine worms of this species were obtained from the intestines of two specimens of *Chelydra serpentina* from Walker, Iowa.

Telorchis medius sp. nov. (Figs. 2, 7)

Sexually mature worms 3 to 5.28 mm. in length; 0.35 to 0.48 mm. in width; body closely resembles *T. corti*. At anterior end cuticular spines 2.8μ in length, in rows 3μ apart. Acetabulum one fifth to one fourth of body length from anterior end; in mounted specimens longer than broad, measuring 0.1 by 0.11 mm. to 0.12 by 0.146 mm. Oral sucker circular or slightly oval, with either diameter greater, varying from 0.115 to 0.146 mm. Short prepharynx shows in well-extended specimens, in sagittal sections measuring 40μ in length. Pharynx broadly oval, 50 to 60μ long and 60 to 70μ broad, followed by long esophagus measuring 0.2 to 0.27 mm. Diverticula extend posteriad to point midway between caudal testis and posterior end of body, diameter 12 to 15μ . Ovary spherical or broadly oval, median, three sevenths of total length from anterior end; diameter 0.15 to 0.2 mm. Figure 7 shows relations of female genital apparatus in ovarian region. Vitellaria extend anteriorly to point midway between caudal end of cirrus sac and cephalic margin of ovary, and posteriad seven eighths of distance from ovary to cephalic testis; lobes usually distinguishable. Eggs 21 by 43μ ; near ovary slightly more spherical, measuring 26 by 42μ . Testes spherical or oval, 0.185 to 0.25 mm. in diameter. Cirrus sac extends from genital pore caudad four fifths to five sixths of distance to ovary. Vas deferens coiled more than in *T. lobosus* and less than in *T. corti*.

T. medius shows more morphological similarity to *T. corti* than to any other known species but the differences constitute sufficient ground for separation. *T. medius* is shorter, more uniform in width, has a much longer esophagus, the cirrus sac extends farther caudad, the acetabulum and ovary are nearer the middle of the body, and the vitellaria do not extend so far anteriorly, the eggs are larger, and considering the differences in the size of the worms the ovary and testes are also larger in *T. medius*.

Eleven mature and sixteen immature specimens were taken from the intestines of three dozen individuals of *Aromochelys odoratus* from Raleigh, N. C.

Telorchis diminutus sp. nov. (Fig. 8)

Mature worms 1.2 to 1.5 mm. in length; 0.2 to 0.25 mm. in width. Greatest width in acetabular region. Acetabulum circular or oval, two sevenths of total length from anterior end; 62 to 80μ in diameter. Oral sucker circular or oval, 75 to 90μ in diameter; pharynx from 30 to 40μ in diameter; esophagus 70 to 100μ in length. Ovary spherical, 60 to 80μ in diameter, caudal margin midway between anterior and posterior ends of body. Receptaculum seminis present, Laurer's canal about 30μ long, opens immediately caudad of ovary. Descending and ascending limbs of uterus usually interwoven and not in distinct fields. Vitellaria poorly developed, not arranged in lobes, extending from ovary posteriad two thirds to three fourths of distance to cephalic testis. Eggs measure 41 by 20μ . Testes spherical or slightly oval, usually longer in the anteroposterior axis, 58 to 76μ by 69 to 92μ . Cirrus sac extends posteriad from genital pore almost to region of ovary; very much coiled.

In general structure *T. diminutus* closely resembles *T. parvus* Braun, but the two species differ in many distinct items. They have approximately the same relative width and correspond closely in position of vitellaria and size of eggs; but *T. diminutus* is smaller, the suckers are larger, the esophagus is shorter, the ceca extend farther

caudad, the cirrus sac does not extend to the ovary as in *T. parvus*, and in *T. diminutus* the collecting duct of the excretory system is dorsal to the testes instead of passing between them in the shape of a letter S.

These parasites were obtained from the intestine of a single specimen of *Cinosternum pennsylvanicum* from Raleigh, N. C. Some thirty worms were found, about half of which were sexually immature.

Telorchis robustus Goldberger (Fig. 6)

The species was described by Goldberger in 1911 from a single specimen which was taken from the intestine of *Cistudo carolina* in Maryland. I have fifteen specimens collected in 1910 from the intestine of *Chrysemys elegans*. A study of these worms affords information which corrects and completes the description of Goldberger. Specimens 6 to 13 mm. in length; 0.8 to 1.3 mm. in width. Acetabulum 0.2 to 0.24 mm. in diameter, located about one fifth of total length from anterior end. Oral sucker usually slightly longer in antero-posterior diameter, 0.25 to 0.28 mm. in the larger specimens. Short pre-pharynx; pharynx 0.14 to 0.17 in diameter; esophagus short, apparent in well-extended specimens. Testes spherical or slightly oval, 0.4 to 0.5 mm. in diameter. Female reproductive organs as described by Goldberger except that Laurer's canal opens some distance posterior to the ovary and the vitellaria do not "extend in intercecal areas," but lie in extracecal margins of body. Eggs (not mentioned by Goldberger) average 15 by 29 μ .

Telorchis aculeatus von Linstow (Fig. 5)

The material consists of 13 specimens collected from the intestine of *Tropidonotus grahamii* in June, 1910.

A careful detailed comparison of the worms with the description and figure of *T. aculeatus* given by Braun (1901) leaves little doubt as to their specific identity and regardless of the wide difference in distribution and host I shall assign the specimens to that species.

SUMMARY

The study of abundant material, both adult and immature forms from the trematode genus *Telorchis*, including four species new to science and others from new hosts and localities, has given data for the first general discussion of the genus yet made. The sub-genera *Telorchis* and *Cercorchis* proposed by Lühe intergrade and can not be retained. *T. angustus* and *T. leptus* if correctly described should be removed to an independent genus. The new and some older species are discussed in detail.

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EXPLANATION OF PLATE

ABBREVIATIONS

<i>a</i> acetabulum	<i>p</i> prostate gland
<i>cs</i> cirrus sac	<i>ph</i> pharynx
<i>e</i> esophagus	<i>sg</i> shell gland
<i>ep</i> excretory pore	<i>sr</i> seminal receptacle
<i>g</i> genital pore	<i>sv</i> seminal vesicle
<i>i</i> intestine	<i>t</i> testis
<i>l</i> Laurer's canal	<i>u</i> uterus
<i>m</i> metraterm	<i>v</i> vitellaria
<i>o</i> ovary	<i>vr</i> vitelline receptacle
<i>od</i> oviduct	<i>vt</i> vitelline duct
<i>os</i> oral sucker	

All drawings are from camera lucida tracings except Figure 7, which is from a reconstruction.

Fig. 1.—Terminal section of the genital ducts in *T. corti*, showing cirrus sac and metraterm.

Fig. 2.—*T. medius*, ventral view, x 28.

Fig. 3.—*T. lobosus*, ventral view, x 36.

Fig. 4.—*T. corti*, ventral view, x 18.

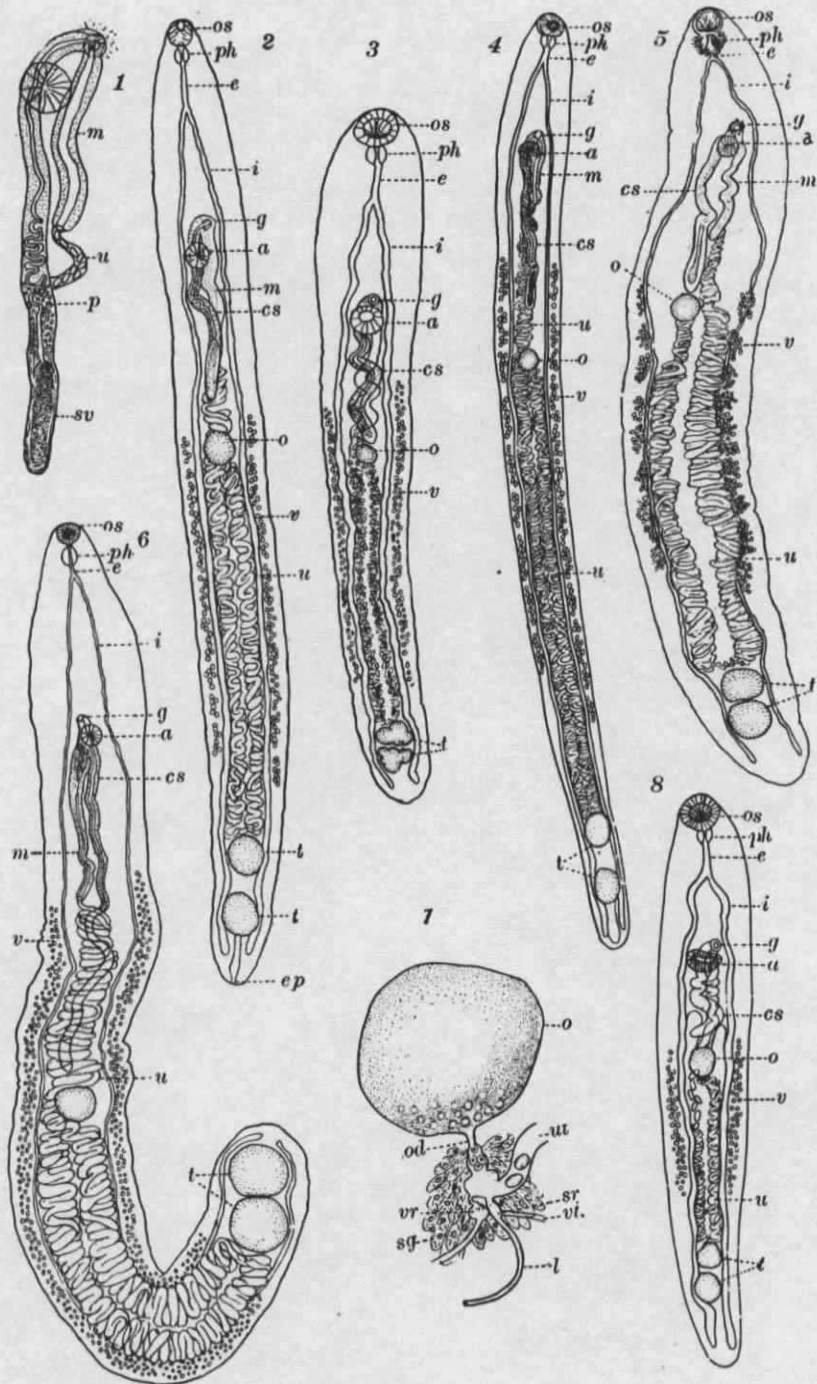
Fig. 5.—*T. aculeatus*, ventral view, x 18.

Fig. 6.—*T. robustus*, dorsal view, x 15.

Fig. 7.—Female genital apparatus, *T. medius*, from reconstruction of frontal sections, x 125.

Fig. 8.—*T. diminutus*, ventral view, x 56.

PLATE 1



Figs. 1-8